ceramic greensheet structures, each layer is personalized (e.g., uniquely screen printed, uniquely punched with a via grid).

In a preferred embodiment, a family of products uses a standard voltage pattern and each member of the family utilizes a subset of the vias, which have been incorporated for various chip sizes or chip footprints, to connect to the standard voltage pattern. Therefore, with the invention, each member of the family takes advantage of the common voltage or reference pattern.

In another embodiment, a common pattern for X, Y or redistribution wiring is made for a given family of products. Each layer is personalized by custom laser deletion of undesired portions of the conductors. This methodology lends itself toward both product specific personalization and to customized patterns and provides a means of repair when used with patterned surface or subsurface layers.

Referring now to Figure 1A, two layers 10, 11 (sheet 1, X wiring and sheet 2, Y wiring) of a ceramic substrate are shown. The layers are pre-drilled with via holes 13 at regular grid locations. Selected vias 12 (indicated by large circles) are filled with an insulating material such that they do not make electrical contact between the layers (sheets). The remainder of the vias are filled with conductors and the conductive wiring pattern applied.

In Figure 1B, a path is personalized on the pair of sheets by filling certain vias with conductors and by removing certain connections. As can be seen in Figure 1B, the path begins at "A." A wire segment is cut at point "B". A

conductive via joins the segments between sheets 1 and 2 at point "C". Segment C-D is similarly isolated by cuts and connected to segment E-F with a conductive via. E-F is similarly connected to G-H to complete the path A-H. The layers are laminated and other layers are similarly personalized and laminated to form the MLC substrate.

Referring now to Figure 2, a flowchart illustrating an embodiment of the invention is shown. In item 20 of the flowchart, a standard (e.g., generic) array of via holes 13 are formed in a sheet 10. Then, in item 21, selected ones of the vias 12 are filled with a non-conductive material. Then, as shown in item 22, a standard (e.g., generic) pattern of conductive wiring is applied and the remaining via holes are filled with a conductive paste. As shown in Figure 1B, selected locations of the generic wiring pattern are cut (item 23) to personalize the sheet. Then, the vias of sheet 10 are aligned with those of sheet 11, as shown in item 24. Finally, in item 25 sheet 10 is laminated to sheet 11.

In the process described above, any conventional method can be used to selectively fill the vias with a conductor or insulator, as shown in Figure 3A, to personalize the otherwise generic sheet. Also illustrated in Figure 3A are the cuts 30 in the generic wiring pattern 31 which personalize the sheet. For example, a stencil, mask or other similar device can be used to selectively fill the vias with an insulator or conductor using any well known screening process. Similarly, the electrical wiring connections 31 can be cut 30 using any well known process, such as laser cutting, physical cutting, etching, sand blasting, punching, electrically

blowing links, grinding, etc. Alternatively, as illustrated in Figure 3B, all the vias are filled with a conductor 13 and insulating caps 32 are formed over selected ones of the conductors 13 to personalize of the sheet. As would be known by one ordinarily skilled in the art given this disclosure, the caps 32 can be formed in any conventional process, such as screening and other similar processes.

Referring to Figure 3C, all wiring (X or Y) layers, 11, have all vias filled with conductive paste. In order to connect only selected vias between two layers, an interposer layer 40 is used with the selected vias, 42 (filled with conductive paste) and the other (nonconducting) vias, 41, are left empty. Connections between successive layers are made through selected vias. Sheet 40 may be of different thickness to maintain overall substrate thickness. This method offers several advantages: first a common punch pattern could be used for all layers, second only simple through via masks are required for interposer layers and third, no insulating (nonconductive) paste screening is required.

Referring to Figure 4, lines are screened such that connections to all of the vias are made. Each layer is personalized based on the design requirements. Connections to vias, 33, that are not supposed to be connected are removed using methods such as laser ablation, e-beam, sandblasting, etc. Advantages of this method include use of common punch and screen pattern and elimination of need for screening with insulating paste.

Thus, as described above, the invention uses common generic pre-drilled/pre-wired substrate sheets that are personalized using cuts (e.g., laser) and